04/16/01 09:14 FAX 515 281 8895 DNR 001

4/16 # 9:10

Iowa Department of Natural Resources
Wallace State Office Building
502 East 9th Street
Des Moines, Iowa 50319-0034

Site: Atlantic WS
ID: IAD039954300
Break: 1.7
Other:
04-16-01

FAX SHEET

DELIVER TO: Don Hamera **PHONE:** (913)551-7818

FAX NUMBER: 913-551-7063

FROM: Bob Drustrup

NUMBER OF PAGES (including this cover sheet): 14

MESSAGE: Here is the most recent information on the Atlantic PCE site. I'll talk to you before our meeting in Atlantic this Wednesday.
Bob D.

1.0

Our Fax Phone Number is 515/281-8895

Any problems with transmission call: 515/281-8941

161227

revised 1/2000(pa)

PRINTED ON 30% POST CONSUMER RECYCLED PAPER

542-1352

04-16-01 09:09 TO:

FROM:515 281 8895

FOLLOW-UP INVESTIGATIONS

OF

PCE CONTAMINATION

IN

GROUNDWATER

ATLANTIC, IOWA

August & November 1998

By

The Iowa Department of Natural Resources
Uncontrolled Sites Section
February 1999

FOLLOW-UP INVESTIGATION OF PCE CONTAMINATION IN GROUNDWATER, ATLANTIC, IOWA

August & November 1998

INTRODUCTION: In 1982 tetrachloroethene (also called perchloroethene or PCE) was first detected in the Atlantic Municipal Utilities Well #7 at a concentration of 170 ug/l. A high of 260 ug/l of PCE was detected in water from Well #7 in 1984. (The drinking water maximum contaminant level for PCE is 5 ug/l.) PCE has sporadically been detected below the MCL in several of the other municipal wells. Since August 1982 the Atlantic Municipal Utilities has pumped Well #7 (more or less) continuously to waste to contain the PCE contamination and prevent it from reaching other wells. Since December 1987 Well #7 has been pumped directly to the sanitary sewer. Pumping Well #7 to waste continues to be an effective means of protecting the other municipal wells. The Atlantic Municipal Utilities has collected monthly samples from Well #7. Sample results suggest a gradual decrease in levels of PCE. An average of about 100 ug/l of PCE has been found in water from Well #7 over the past several years.

In August of 1987 Ecology & Environment, Inc., under contract with the U.S. Environmental Protection Agency, conducted a soil-gas investigation that delineated the extent of PCE contamination. Results from the 1987 Ecology & Environment investigation suggested a source of contamination just south of 7th St. (U.S. Highway 6) between Buttermilk Creek and Plum St. (Figure 1) The area of highest PCE contamination found in the 1987 study was in front of the fast-food restaurant just west of Buttermilk Creek. A couple hundred feet to the west of this contaminant "hot spot" is the location of a former (i.e., 1974-1986) Iowa Department of Transportation (IDOT) material testing laboratory. This location is also believed to be the site of a dry cleaning business prior to about 1960. PCE is a solvent commonly used for dry cleaning and metal degreasing. The 1987 study hypothesized that a solvent spill by the former dry cleaner or testing lab migrated by surface runoff and groundwater flow to the hot spot found in front of the fast-food restaurant, possibly being expedited by the 7th St. storm sewer system.

The 1987 investigation conducted by Ecology & Environment, Inc. involved primarily soil-gas sampling and on-site analyses of the soil-gas samples. Soil-gas samples were collected by driving a pipe about 5-6 feet into the ground. A vacuum was then imparted on the pipe to extract soil gas from inlet ports near the bottom of the pipe. A portable gas chromatograph was used to analyze the soil gas samples. The detection limit for PCE in the 1987 study was about 0.1 ug/l which is equivalent to about 0.01 PPM. The highest level of PCE detected was 119 ug/l (17.5 PPM). As part of the 1987 investigation, three soil samples were collected at depths of 5 feet or less in the areas with the highest levels of PCE in the soil-gas samples. Only low levels of PCE were found in the soil samples (i.e., 0.002 mg/kg, 0.020 mg/kg, and 0.029 mg/kg).

In August of 1998 the Iowa Department of Natural Resources (DNR) conducted a follow-up investigation of PCE contamination in groundwater that has impacted the Atlantic Municipal Utilities' public water supply. Additional follow-up investigation was conducted by DNR in November 1998. The objective of the 1998 investigations by the DNR was to better define the source of the PCE contamination.

PROCEDURES: The 1998 investigations primarily utilized soil-gas sampling similar to the 1987 investigation. A Geoprobe® was used to drive rods into the ground for collecting soil-gas samples. Figure 2 is a schematic of the soil-gas sampling set-up. Soil-gas samples were collected at depths ranging from 6 to 30 feet. After reaching the desired depth, a vacuum was placed on the sampling system and at least 2 liters of air was purged prior to collecting the soil-gas sample. Soil-gas samples were analyzed directly with the DNR's portable gas chromatograph. A detection limit of about 0.01 PPM was achieved for PCE in air which comparable to the 1987 study.

Soil samples were also collected using the Geoprobe® by pushing a 4-ft. long, solid-tube core sampling device. Continuous, 1.5 inch-diameter soil samples were collected with this equipment. The gas chromatograph was used to indirectly analyze soil samples. Quart glass jars were filled roughly half full with each soil sample. The lid was then placed on the jars, they were microwaved for about a minute, and the headspace was then analyzed.

RESULTS: Figure 2 shows the locations of samples collected during the 1998 investigations. A total of 25 soil-gas and 10 soil samples were collected and analyzed as part of the August 1998 field work. An additional 9 soil-gas samples were collected and analyzed in November 1998. Table 1 summarizes soil-gas results. Figure 3 graphically displays soil-gas results.

Table 2 summarizes soil results. It should be noted the soil-headspace results are not a direct representation of PCE concentrations in soil. They do provide a good comparison of relative levels of PCE and, based on previous work, a headspace reading of 100 PPM of PCE roughly correlates to 1 mg/kg (1,000 ug/kg) of PCE in soil.

The two soil samples were collected in close proximity to each other. The second soil sample was located 12 feet east of SG-15. In Table 2 the samples representing a depth range (e.g., 4-8 ft.) were composited over that range. The samples identified by a single depth were not composited. The soil corings showed a general soil profile as follows.

Depth	Material
0-1 ft.	Fill
1-6 ft.	Silt with some clay
6-12 ft.	Silt with more clay
12-15 ft.	Sand
15 + ft.	Silt with some clay

Attempts to collect groundwater samples were made at two locations. A half-inch diameter PVC pipe with a 5 ft. bottom screened section was placed in the second soil-core hole (between SG-15 and SG-16) to a depth of 17 feet. No water was found in the well after one day. This temporary well was left in-place and no water has subsequently been found in it. An attempt to collect groundwater was also made in August at the SG-22 location. Probe rods were driven to a depth of 30 feet and the pipe was left in the ground overnight. No water was found in the pipe the following morning. A 30-ft. deep soil-gas sample was then taken from the pipe and the rods were retracted. The openings in this temporary well may have been smeared shut during installation, thus preventing groundwater from entering the well. In November another attempt to collect groundwater was made near the SG-22 location. Probe rods were driven to a depth of 33 feet and then retracted. Thirty-three feet of half inch plastic pipe with a 5 ft. bottom screened section were placed in the hole. No water was found in this well initially or the following day. All but 10 ft. of the pipe were removed and the hole was sealed with bentonite pellets.

DISCUSSION: The findings from these investigations were similar in many respects to the 1987 investigation. Two lobes of contamination—in front of the fast-food restaurant and near the former dry cleaners/IDOT lab—with an area of very low soil-gas contamination in-between were found in both studies. The highest level of PCE in soil-gas found in the 1987 study was 119 ug/l (17.5 PPM) in front of the fast-food restaurant. A comparable level, 16.3 PPM, was found in the same general area in the current study. However, the 1987 study found a maximum level of PCE in soil gas in the former dry cleaners/IDOT lab area of only 35.6 ug/l (5.2 PPM). With the greater number of samples taken in this area during the 1998 investigation, a substantially different picture of contaminant occurrence was found. PCE in soil gas was found in excess of 10,000 PPM in one soil-gas sample and was found in several other samples in this area at levels much greater than found near the fast-food restaurant.

Based on these findings it can be concluded that the primary source of PCE contamination is not in front of the fast-food restaurant as previously believed. Instead, the former dry cleaning/IDOT lab area appears to be the primary contaminant source area (Figure 4). Despite lack of information regarding the reported former dry cleaners, the evidence strongly suggests that such a business did exist and was the source of PCE contamination. Dry cleaners commonly use and have used PCE in significant quantities. It is doubtful that the former IDOT lab even used PCE and, if it did, it would likely have been in very small quantities.

The soil sampling identified significant PCE contamination in the clayey silt material (i.e., loess) to a depth of at least 20 feet. The sand lens found at 12 -15 feet had only very low levels of PCE. This finding illustrates how the finer silts and clays retain PCE to a much greater degree than the coarser sand.

The current investigation was not able to identify the groundwater table to a depth of 33 feet. The relatively deep water table leaves a large unsaturated zone above it in which contaminants may reside. The depth to which contaminants exist in this unsaturated zone has not been determined.

In the report on the 1987 investigation, it was hypothesized that surface and groundwater runoff, possibly expedited by the storm sewer, accounted for the high level of PCE in front of the fast-food restaurant. (That area was assumed to be the primary source of contamination based on that information.) All of those methods of PCE migration could have occurred. In addition, direct discharge of PCE to the sanitary sewer, which subsequently leaked, could also have occurred. Regardless, it appears that the silty, clayey soils to a depth of at least 20 feet in the area of the former dry cleaners is the predominant source of PCE contamination that impacts groundwater.

The deep soil contamination could also be the result of incidental leaks and spills during normal dry cleaning operations, as well as a possible larger spill or spills.

The soil-gas sample with the highest level of PCE (>10,000 PPM at location SG-25) was collected in the middle of a concrete parking lot at a depth of 9 feet. A 6-ft. deep soil-gas sample taken at the same location revealed only 0.39 PPM of PCE. This brings into question the variability of PCE levels in soil gas with depth. The SG-25 location was the only paved location that was sampled. Soil gas is expected to generally diffuse upward through the soil profile to the atmosphere. Pavement will inhibit movement of soil gas to the atmosphere. Therefore, soil gas may move laterally under a paved area, possibly explaining the low concentration of PCE found in the 6-ft. sample collected at SG-25. Follow-up soil-gas sampling in November was conducted at multiple, deeper depths to determine if large variations in PCE concentrations existed with depth elsewhere. Substantially higher PCE levels were found at greater depths in SG2-3 sample location. This phenomenon was not found in the other areas sampled. The findings support the interpretation of the primary PCE source area as shown in Figure 4.

PCE is a material that is heavier than water (called a "dense non-aqueous phase liquid" or DNAPL). Such materials can sink below the groundwater table and pool in low areas on top of an impermeable material such as shale. Liquid PCE can also become trapped in the cracks in bedrock or pore spaces between soil particles above and below the water table. If a DNAPL situation exists below the water table, it may constitute the primary source of groundwater contamination in which case total cleanup of soil above the water table would not resolve the groundwater contamination problem. The information currently available cannot confirm or deny the existence of a deep DNAPL situation.

CLEANUP OPTIONS: Assuming the assessment of the contaminant source area provided in this report is confirmed by the subsequent investigation and a deep DNAPL situation does not exist, several approaches to cleanup of the site will likely be available. If a significant DNAPL situation is found, cleanup options will have to be re-evaluated. Cleanup options fall into 3 general categories: containment, ex-situ source control, and in-situ source control.

Containment.

Containment involves physically limiting migration of contaminants. This can be done with physical barriers to groundwater flow (e.g., sheet piling) or hydraulic barriers, i.e., wells that intercept contaminants before they migrate elsewhere. Physical barriers may still require pumping of groundwater from within or upgradient of the barrier, thus often providing little benefit over hydraulic containment alone.

Well #7 has been operating as an "interceptor well" to provide hydraulic containment. It has been proven to be successful, but has the disadvantages of having no end in sight and leaving groundwater contamination in the area between the source and Well #7.

A new groundwater interceptor well (or wells) could probably be located at or near the PCE source area to intercept contaminants before they migrate towards Well #7. This would have the advantage of providing for accelerated cleanup of groundwater between the source area and Well

#7. However, Well #7 would still have to be pumped to waste for some period of time (several years??) until the contaminants had sufficient time to flush out of the system. An interceptor well (or wells) near the source area would likely have the advantage of pumping at a lesser rate than Well #7, eventually resulting in lower power costs for pumping. Handling of water from a source-area interceptor well may require additional treatment, if direct discharge to the sanitary sewer is not appropriate. Such additional treatment would likely be air stripping and/or carbon adsorption, either or both of which would require ongoing maintenance and cause a substantial increase in costs. Without source removal activities, a source-area interceptor well would also have to be pumped for an indefinite period of time.

Ex-Situ Source Control.
Ex-situ source control would involve excavating the highly contaminated soil that is a source of groundwater contamination. The soil would then have to be treated and disposed of properly. In the likely event that the excavated soil would be considered a hazardous waste, disposal would have to be at an off-site hazardous waste disposal facility (e.g., hazardous waste landfill , incinerator). On-site treatment options would likely not be possible do to the limited area and surrounding development. Since there are no licensed hazardous waste facilities in Iowa, off-site disposal and/or treatment would involve transporting the material out of state. Assuming a 70 ft. by 70 ft. by 25 ft. deep area of excavation, costs could easily exceed $1,000,000. Substantially lower costs could be realized if all or some of the excavated soil was not classified as a hazardous waste, in which case it could probably be taken to a local, permitted landfill.

In-Situ Source Control.
In-situ source control measures would involve managing contaminants in-place, i.e., without excavation. In-situ methods may involve physically stripping contaminants from soil particles, biologically degrading the contaminants, or immobilizing the contaminants so they can no longer migrate to groundwater. Biological treatment techniques are largely unproven but may be worth pursuing if a vendor is willing to demonstrate the effectiveness of their process at the site. In-situ immobilization techniques (e.g., heating contaminated soil to a molten mass that hardens like glass) tend to be very expensive and would probably not be suitable for this site. The most proven in-situ method for stripping of contaminants from soils is a process called soil vapor extraction (SVE). SVE simply involves placing a vacuum on wells screened above the water table to greatly accelerate airflow through subsurface soils. Volatile contaminants (e.g., PCE) are stripped from the soil to the passing air and exhausted to the atmosphere from the vacuum pump. Treatment of air before it is discharged to the atmosphere (typically carbon adsorption) may be required to meet air quality regulations.

SVE may be an effective and economical remedial method for the Atlantic site. For SVE to be effective it must be possible to obtain a good airflow through the subsurface soils. Removal of contaminants from soil is directly related to the amount of airflow that can be induced. Therefore, SVE does not work well in very tight soils. The soil-gas sampling conducted at the site provided a general indication of the ability to move air through the subsurface soils. Generally good air movement was noted during the soil-gas sampling which suggests that SVE may be effective. The apparent source area is under a concrete parking lot. This situation may increase initial costs of installing an SVE system, but may enhance performance of the system. Impermeable caps are sometimes placed over SVE remediation areas to prevent short circuiting of air from the surface.

RECOMMENDATIONS: Installation of a groundwater monitoring well at the source area (i.e., the vicinity of SG-11, SG-12, SG-25, and SG2-3) is recommended. Such a well would serve multiple functions. Soil sampling during installation would provide information on the magnitude and distribution of contaminants in subsurface. Groundwater samples together with soil samples should enable the determination of whether or not a DNAPL situation exists. A monitoring well could also be constructed to serve as an interceptor well. Another monitoring well in the vicinity of SG-20 is recommended. The main purpose of such a monitoring well would be to determine whether or not soil and groundwater contamination exist that are indicative of a significant contaminant source in the near vicinity. Groundwater sampling on the north side of Highway 6 by Geoprobe® or monitoring wells may also be beneficial in confirming contaminant source areas. After the above-recommended work is completed, clean-up actions can be selected. If the current assessment is confirmed and a significant DNAPL situation is not found, a soil vapor extraction and/or other remedial pilot study will likely be warranted prior to final selection of a clean-up plan.

The issue of liability for additional investigation and any subsequent clean-up action is not straightforward. There is little information regarding the party that likely caused the contamination (i.e., the former dry cleaners). The former dry cleaners is probably not a viable responsible party. The current owner of the property, the nearby bank, clearly did not contribute to the contamination. Therefore, under the "Blue Chip" ruling by the Iowa Supreme Court, the bank could be liable only for certain investigative costs. Since the contamination impacts a public water supply with no clear, viable responsible party, it is recommended that the Iowa Hazardous Waste Remedial Fund be used to assist the Atlantic Municipal Utilities in pursuing additional investigative and clean-up activities at the site.

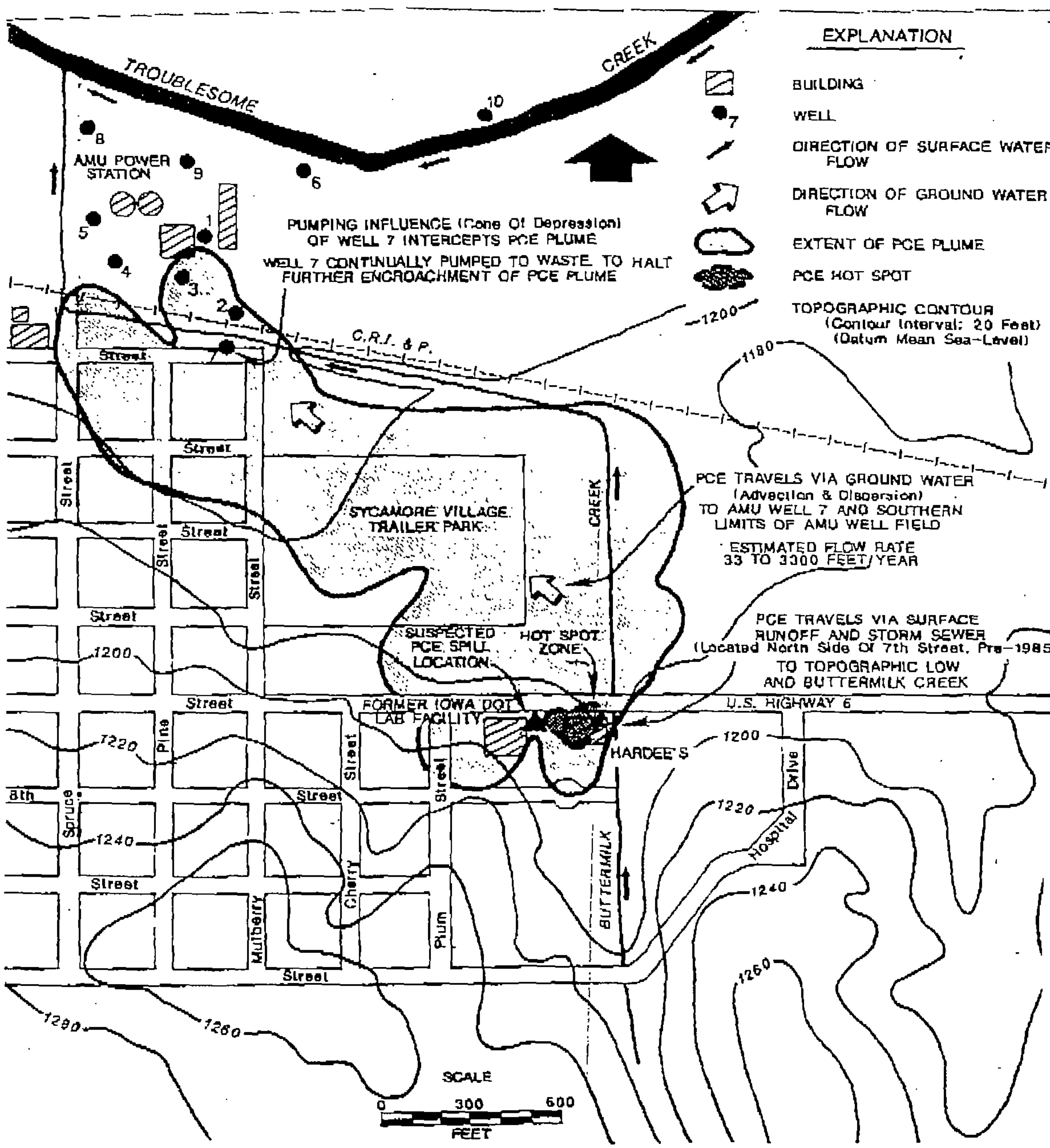
TABLE 1
SOIL-GAS RESULTS

Sample Location No.	Sample Depth (Ft.)	PCE Concentration (PPM)
SG-1	6	2.85
SG-2	6	7.23
SG-3	6	5.63
SG-4	6	2.27
SG-5	6	4.30
SG-6	6	0.00
SG-7	6	0.02
SG-9	6	0.72
SG-10	6	58.2
SG-11	6	72.5
SG-12	6	5.29
SG-13	6	1.76
SG-14	6	5.24
SG-15	6	526
SG-16	6	412
SG-17	6	4.72
SG-18	6	1.34
SG-19	6	6.03
SG-20	6	16.34
SG-21	6	18.79
SG-22	30	1.05
SG-23	6	0.02
SG-24	6	0.89
SG-25-6	6	0.39
SG-25-9	9	>10,000
SG2-1-9	9	0.13
SG2-1-15	15	0.00
SG2-1-18	18	0.06
SG2-2-9	9	2.60
SG2-2-12	12	1.03
SG2-3-9	9	1,285
SG2-3-12	12	1,696
SG2-4-9	9	27.06
SG2-4-12	12	3.21

TABLE 2
SOIL HEADSPACE RESULTS

	Sample Depth (Ft.)	Headspace PCE (PPM)
Sample 1	1-6	3.2
	6-12	140
	12-14 (sand)	0.50
Sample 2	0-4	14
	4-8	28
	8-12	390
	12-16	560
	16-20	300
	15 (sand)	4.30
	16	350

FIGURE 1 Generalized 1987 Study Results



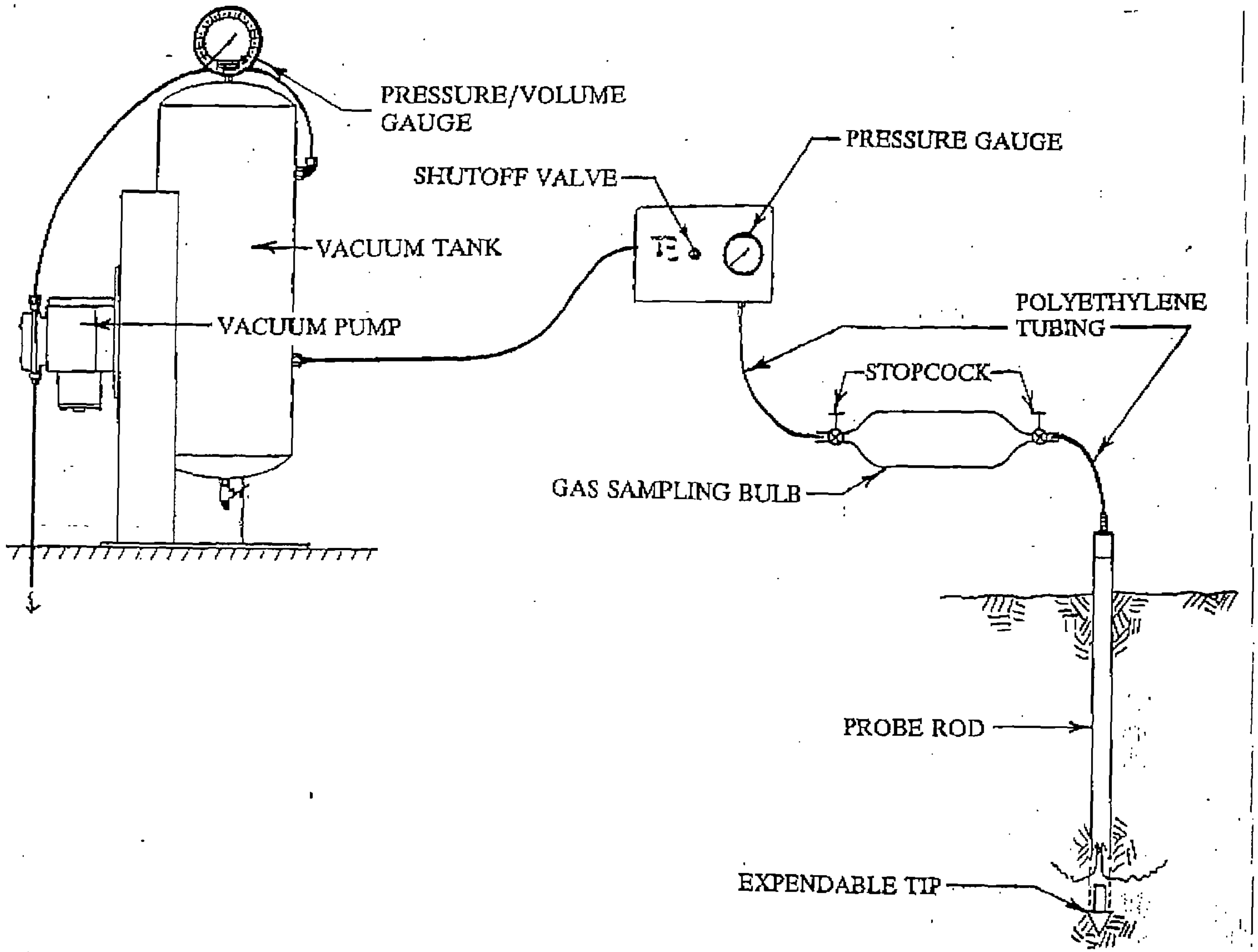


FIGURE 2 Soil-Gas Sampling Procedure

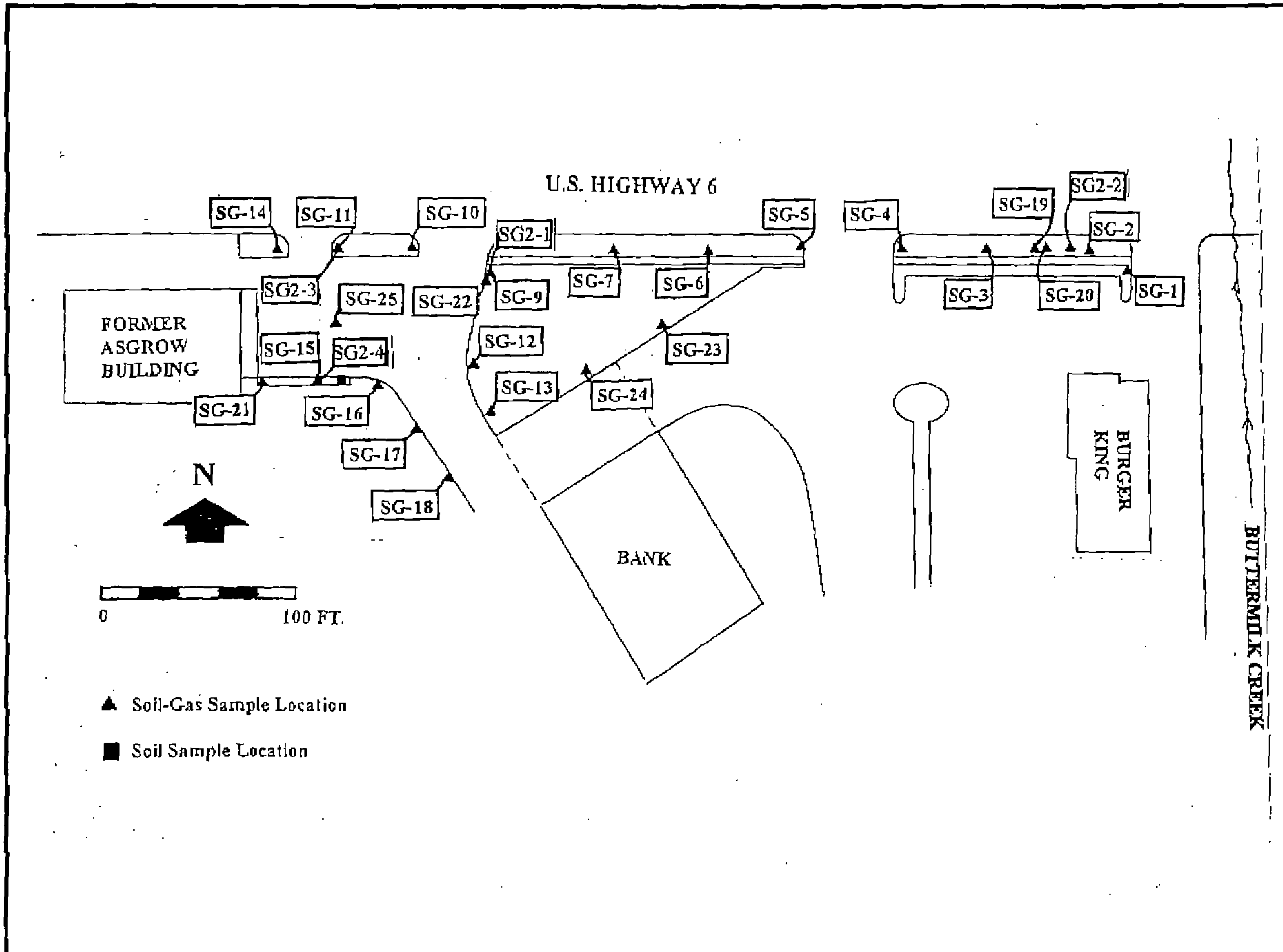


FIGURE 3 Sampling Locations

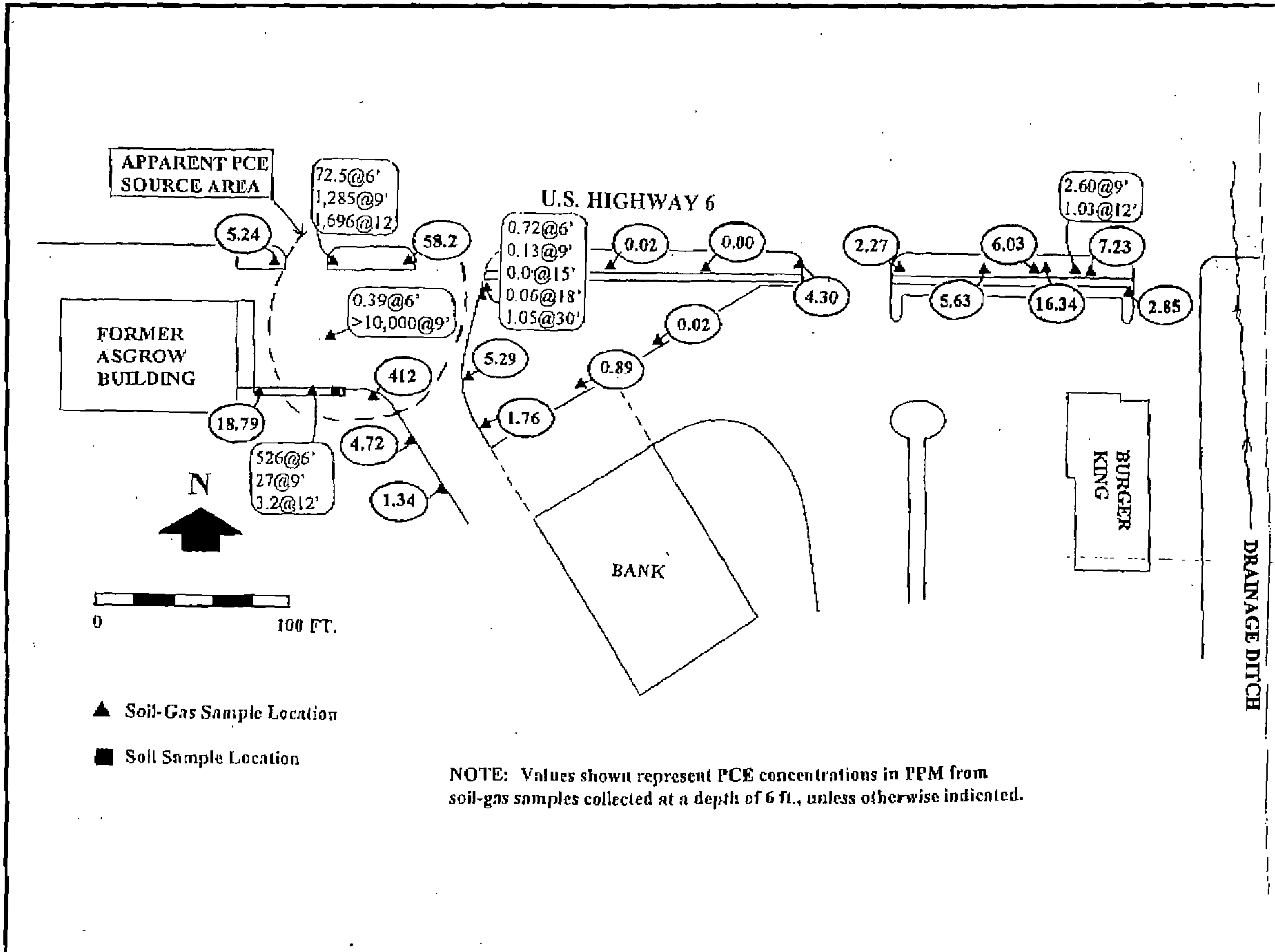


FIGURE 4 Soil-Gas Sampling Results (PCE in PPM)